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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/022,133	12/13/2001	Marco Corbetta	BLASP0100US	2796

7590 10/23/2003

Thomas W. Adams
Renner, Otto, Boisselle, & Sklar, LLP
Nineteenth Floor
1621 Euclid Avenue
Cleveland, OH 44115

EXAMINER	
LEHNER, WILLIAM P	
ART UNIT	**PAPER NUMBER**
2671	6

DATE MAILED: 10/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

7

Office Action Summary	Application No. 10/022,133	Applicant(s) CORBETTA, MARCO
	Examiner William P Lehner	Art Unit 2671

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 December 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *16* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," and in further view of Foran (5742749).

3. In regard to claim 1, note in Frazier (1) the method of creating shadows (page 1, line 2). Frazier does not create soft shadows. Kato creates soft shadows because they appear natural (column 6, lines 18-33). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to create soft shadows as taught by Kato because they appear natural.

4. Frazier (1) has shadow volumes (page 1, line 2). Volumes and cubes imply a 3D scene. Polygons cast shadows on other polygons (page 1, lines 12-13).

5. Frazier (1) does not compute soft shadow edges from edges casting shadows. Kato's FIG. 66 demonstrates soft shadow edges on shadow polygon 425 from edges

casting shadows from cube 420 because this is used to create the soft shadow. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to compute soft shadow edges from edges casting shadows as taught by Kato because this is used to create soft shadows.

6. Frazier (1) creates six faces of a cube map representing a cube centered at the light source (page 1, line 31). Although this paper does not say the cube is aligned with orthogonal major axes, it is expressed in Frazier (2) (page 11, lines 10-12).

7. Frazier (1) shows the scene rendered on all six faces of the cube with full brightness and color (page 2, FIG. 1 and lines 1-5). As mentioned above, Kato teaches rendering soft shadows using edges casting shadows and computing soft shadow edges.

8. From the point of view of the viewer, Frazier (1) computes the distance or depth from the camera to polygon pixels (page 1, lines 14-15). Although this paper does not say this depth is stored in a z-buffer or depth-buffer, it is expressed in Frazier (3) (page 13, line 5).

9. Frazier (1, 2, 3) and Kato do not render the scene into the z-buffer with the light, colors, and textures disabled. Kilgard provides code to perform this depth test with the lighting disabled and colors not updated because it saves time (page 26 line 8 and page 27 comment in line 2). Kilgard does not bother with lighting and colors because they are appearance-related and not necessary to determine z-values; texture is also appearance-related and not necessary. Therefore, it would have been obvious to one of

ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to disable lighting, colors, and textures as taught by Kilgard because it saves time.

10. Frazier (1) renders shadow volumes into a stencil buffer (page 11, lines 10-12) in combination with the depth-buffer information (page 13, lines 4-7).

11. Frazier (1, 2, 3), Kato, and Kilgard render the full scene, apply a cube map for rendering soft shadows, and use a stencil test to prevent the scene to be drawn in shadowed areas, but use depth coordinates instead of texture coordinates in the stencil test. Foran teaches that depth coordinates are generated as if they were texture coordinates (column 11, lines 10-25) because these coordinates can be converted from light coordinates and project the texture map into the scene being rendered (column 7, line 60 – column 8, line 3). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to use texture coordinates as taught by Foran because they can be converted from light coordinates and project the texture map into the rendered scene.

12. Frazier (1, 2, 3), Kato, and Kilgard do not perform the shadow test and render the scene in one pass. Foran teaches that the shadow test pass and the pass that draws the scene with full illumination can be combined into a single pass (column 10, line 59 – column 11, line 6) because this would be faster. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to combine the shadow testing pass and rendering pass as taught by Foran because it would be faster.

13. In regard to claims 2 and 12, Frazier (3) says that color 1 and color 2 contain alpha values and they are blended (page 1, lines 19-41). Again, Kato teaches that the shadow casting edges are used to compute the soft shadow edges.

14. In regard to claims 3 and 13, Frazier (1) computes shadow polygons but does not create soft shadow polygons that are dark on one edge and bright on another. Kato teaches that the interior of the basic shadow polygon and the boundary between the basic shadow polygon and detailed shadow polygons have a concentration gradation of 1 (full ambient darkness). The outer contour of the detailed shadow polygons and triangles have a concentration gradation of 0 (full ambient brightness). The concentrations of the regions in between are linearly interpreted because this creates a soft shadow that fades from darkness to brightness (column 41, lines 50-62 and FIG. 66). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to create soft shadow polygons that are dark on one edge and bright on another as taught by Kato because it would be possible to interpolate between full ambient brightness and full ambient darkness to create a fading soft shadow.

15. In regard to claim 11, note in Frazier (1) code for a computer program (page 3), and the above rejections to claim 1.

16. Claims 4, 5, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further

view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), and in further view of Peercy (5880736). Frazier (1, 2, 3) does not compute vertices of additional shadow polygons. Kato generates soft shadow polygon vertices from a vector extending outward by a predetermined distance δ (column 41, lines 43-47). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) to generate soft shadow polygon vertices by extending outward along a vector by a predetermined distance δ as taught by Kato because this creates additional soft shadow polygons.

17. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not compute a vector given by a cross product between a normalized vector along shadow casting edges and a surface normal. Peercy calculates a cross product between a shading vector and a normal at the surface to determine how the surface is shadowed (column 5, lines 25-31). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to calculate a cross product between a normalized vector along shadow casting edges and a surface normal as taught by Peercy because this determines how the surface is shadowed.

18. Claims 6, 7, 9, 10, 16, 17, 19-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further

view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), and in further view of Snyder (6252608).

19. In regard to claims 6 and 16, in Frazier (3), note "real-time" in the title. Also, frustums, or views of the cube map need to be rebuilt or updated because of movement by objects or light (page 13, lines 15-17). Frazier (1, 2, 3), Kato, Kilgard, and Foran do not require an update for a change in the viewer's position, direction of view, or field of view. Snyder requires an update for viewpoint movement (column 12, line 33) because viewpoint movement changes the scene. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to require an update for a change in position of the viewer, direction of view, or field of view as taught by Snyder because viewpoint movement changes the scene.

20. In regard to claims 7 and 17, Frazier (1, 2, 3) and Kato do not say that they clear the stencil buffer. Kilgard clears the stencil buffer (page 25, line 20) because if it was not cleared at the beginning it may contain an incorrect value. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to clear the stencil buffer as taught by Kilgard because it prevents errors.

21. Frazier (1, 2, 3) and Kato do not say they performs a per-pixel stencil operation, increase a value in the stencil buffer for front-facing polygons if the depth of the shadow

volume polygon is less than the depth stored in the z-buffer, and decrease the stencil buffer for back-facing polygons if passing a depth test. Kilgard performs a per-pixel stencil operation, increments the stencil buffer for front-facing polygons, and decrements the stencil buffer for back-facing polygons (comments on page 36) because this creates shadow volumes. This depth test passes when a rendered pixel is closer than the value in the depth buffer (page 27, lines 1-5). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to perform a per-pixel stencil operation, increase a value in the stencil buffer for front-facing polygons if the depth of the shadow volume polygon is less than the depth stored in the z-buffer, and decrease the stencil buffer for back-facing polygons if the depth of the pixel is less than the value in the depth buffer as taught by Kilgard because this creates a shadow volume.

22. In regard to claims 9 and 19, Frazier (3) has multiple lights (page 1, line 22). Because the cube map only has one origin at the position of the light source, multiple light sources mean multiple cube maps.

23. In regard to claims 10 and 20, Frazier (1, 2, 3), Kato, Kilgard, and Foran do not have characteristic points of shadows, frames of animation, and threshold values. Snyder teaches frames of animation, storing the location of characteristic points of shadows, and re-rendering shadows if the difference of the characteristic points between subsequent frames exceeds a threshold value, because this evaluates the accuracy of the shadow map for re-use (column 88, line 57 – column 89, line 2). Therefore, it would have been obvious to one of ordinary skill in the art at the time the

invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to have characteristic points of shadows, frames of animation, and threshold values as taught by Snyder because this evaluates the accuracy of the shadow map for re-use.

24. In regard to claim 21, Frazier (3) has a color buffer that stores color values (page 1, line 33), a depth buffer that stores depth values (page 3, lines 36-37), and a stencil buffer for storing stencil mask information (page 11, line 2).

25. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not say they have texture memory, a rasterizer, or pixel engines. Snyder has a rasterizer in communication with a pixel engine (FIG. 4B, elements 464 and 466), a pixel engine includes the z-buffer and stencil buffer for each pixel (column 19, lines 30-42), and a tiler containing and communicating with a texture memory and a pixel engine (FIG. 9B, elements 378, 402, and 406) because they perform the depth test, stencil test, and other operations necessary for the invention. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to have a rasterizer, pixel engine, texture memory in communication with each other as taught by Snyder because they perform the operations necessary for the invention.

26. In regard to claim 22, Frazier (3) has an alpha buffer to bump the display to 32 bits (page 1, lines 23-24).

27. Claims 8 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further view of Frazier (3)

"Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), in further view of Snyder (6252608), and in further view of Dietrich "Cube Maps". Frazier's stencil buffer rejects pixels based on the value in the stencil buffer ("Advanced Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," page 11, lines 4-6).

28. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not say they access the cube map faces by the greatest magnitude coordinate and select texels by the other two components. Dietrich accesses the cube map faces by the greatest magnitude coordinate and selects texels by the other two components (page 3) because this is a simple way of accessing faces and selecting texels. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to access the cube map faces by the greatest magnitude coordinate and select texels by the other two components as taught by Dietrich because it is simple.

29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William P Lehner whose telephone number is 703-305-0682. The examiner can normally be reached on 8:30 - 5 M-F.

30. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman can be reached on 703-305-9798. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

31. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-0377.

WPL

MARK ZIMMERMAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600